

# NSW research results

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# Grain sorghum – managing irrigation, nitrogen, hybrid selection and plant population – Breeza 2012–13

Loretta Serafin, Guy McMullen, Nicole Carrigan and Peter Perfrement NSW DPI, Tamworth

## Key findings

The use of one in crop irrigation increased grain yields by 0.86 t/ha, reduced grain protein by 0.5% and increased 1000 grain weight.

Increasing plant populations from 50 to 100 or 150,000 plants/ha increased grain yields by 0.5 and 0.7 t/ha, respectively. MR 43 and MR Bazley were more responsive to increasing plant population than Enforcer.

Varying nitrogen (N) rate had little impact on grain yield or quality at Breeza in 2012–13. The primary impact of N application was on increasing grain protein levels with each additional rate of N.

Individual hybrids had varying impacts from altering the management practices. MR 43 and MR Bazley performed similarly under most variations. Enforcer was lower yielding regardless of agronomic management.

## Introduction

Grain sorghum grown under irrigation is a small but important part of irrigated farming systems in the northern grains region. Research on irrigated grain sorghum aimed at maximising grain yield, particularly in seasons where limited irrigation water is available is minimal. This trial aimed to investigate the impact of varying four of the most important agronomic management practices in sorghum production (hybrid selection, plant population, irrigation management and nitrogen rate).

## Site details

### 2012–2013

Location:	<b>Liverpool Plains Field Station, Breeza</b>
Planter:	<b>Monosem double disc precision planter on a 90 cm row spacing.</b>
Sowing date:	<b>2nd November, 2012</b>
Insecticides:	<b>4th January – Karate® applied by plane</b>
Harvest date:	<b>21st May, 2013</b>

## In-crop rainfall (mm)

Nov 12	Dec 12	Jan 13	Feb 13	Mar 13	Apr 13	May 13	Total
12.5	27	138	127	76	5	17	402.5

## Treatments

- Two irrigation treatments:
  - I-0 = dryland
  - I-1 = 1 irrigation – applied 9th January, 2013

Bare beds were left between irrigation treatments to minimise lateral movement of water. Additional buffers were also sown alongside the experimental beds to reduce any edge effects.

- Three sorghum hybrids: **Enforcer, MR Bazley and MR 43**
- Three target plant populations: **50, 100 and 150,000 plants/ha**
- Four nitrogen rates: **0, 50, 100 and 200 kg /ha Nitrogen applied as Urea at sowing**

## Starting soil nutrition

Starting soil tests showed there was 114 kg N/ha to a depth of 120 cm. Hence there was sufficient nitrogen in the profile to produce around 3.5 t/ha at 10% protein prior to the application of any additional nitrogen.

**Table 1.** Soil test results

Soil Depth (cm)	Total N (mg/kg)	Sulphur (mg/kg)	Organic Carbon %	pH Level (CaCl <sub>2</sub> )	Phosphorus (Colwell) mg/kg	Phosphorus (BSES) mg/kg	Potassium (Colwell) mg/kg	Zinc (DTPA) mg/kg
0–10	15.3	4.7	0.86	7.9	31	462.88	469	2.84
10–30	28.08	6.2	0.65	7.9	20	465.61	310	1.10
30–60	23.73	5.3	0.54	8.0	13	–	222	–
60–90	35.1	10.0	0.50	8.1	21	–	270	–
90–120	11.79	16.7	0.38	8.3	25	–	270	–

## Results

### Grain Yield

Significant yield responses were recorded for population, irrigation and hybrid treatments; however there was no effect of varying nitrogen application rate. The addition of one in crop irrigation increased yields from 5.64 t/ha in the dryland treatments to 6.50 t/ha, averaged across the three sorghum varieties.

Averaged across hybrid, the 100 and 150,000 plants/ha treatments yielded significantly more than the 50,000 plants/ha treatment by 0.71 and 0.54 t/ha, respectively.

Both MR 43 and MR Bazley performed similarly, yielding more than Enforcer. However there were some interactions between hybrid, plant population and irrigation. All three hybrids had increased yield with the the addition of an irrigation.

MR 43 and MR Bazley were more responsive to increasing plant population than Enforcer (Table 2). Both MR Bazley and MR 43 showed an increase in yield when plant population increased from 50 to 100, 000 or 150,000 plants/ha.

**Table 2.** Effect of varying hybrid and plant population on grain yield (t/ha)

Population ('000/ha)	Hybrid		
	Enforcer	MR Bazley	MR43
50	5.44	6.12	5.85
100	5.75	6.91	6.90
150	5.67	6.65	6.72

### Grain Quality

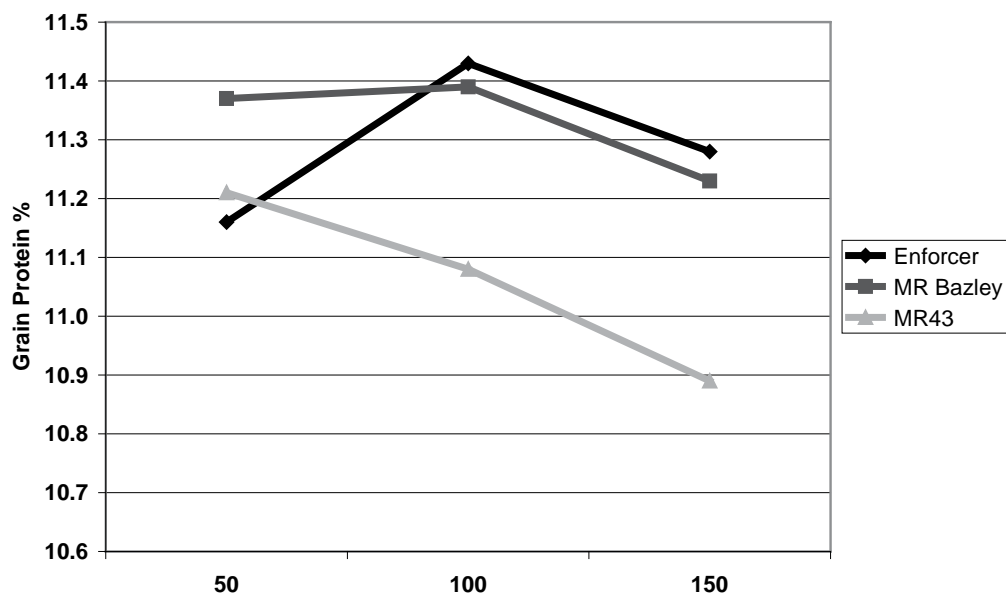
Grain quality was assessed through measuring protein, screenings, 1000 grain weight and hectolitre weight.

#### Protein

Varying irrigation, hybrid, plant population and nitrogen rate also had significant impacts on grain protein. The average protein from the site was 11.2%. Increasing the nitrogen rate significantly increased grain protein by 1% at the 200 kg N /ha application rate.

As would be expected the addition of irrigation reduced the grain protein content, as the protein was diluted by the extra yield obtained from the additional water which was available (data not shown).

Increasing plant population showed small but significant impacts on grain protein. In MR 43 grain protein declined as plant population increased, whereas with MR Bazley and Enforcer there was a slight increase in grain protein when the plant population increased from 50 to 100,000 plants/ha and then a decline at 150,000 plants/ha (Figure 1).



**Figure 1.** Impact of varying plant population on grain protein of three sorghum hybrids – Breeza 2012/13.

### Screenings

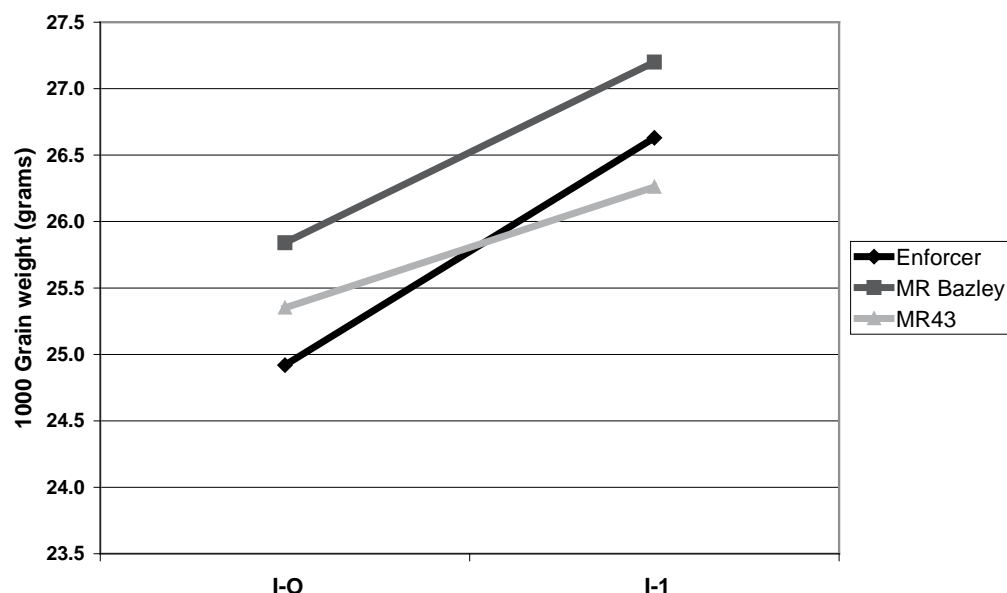
There were significant differences in screenings as a result of both hybrid and irrigation treatments, however varying hybrid had the largest impact on screenings. There was no significant difference in screenings for both MR 43 and MR Bazley regardless of irrigation treatment which were also both below the 11% receival standard for sorghum 1 classification (Table 3). However, Enforcer had significantly higher screenings with the addition of one irrigation. Both of the screenings levels for Enforcer were sufficiently high to result in a downgrade to sorghum 2.

**Table 3.** Effect of irrigation on screenings (%) across hybrid (Values followed by the same letter are not significantly different at the 95% confidence level).

Irrigation	Screenings (%)		
	Enforcer	MR Bazley	MR43
I-O	13.7 b	10.7 c	10.1 c
I-1	16.3 a	10.3 c	10.2 c
l.s.d (P=0.05)	1.8		

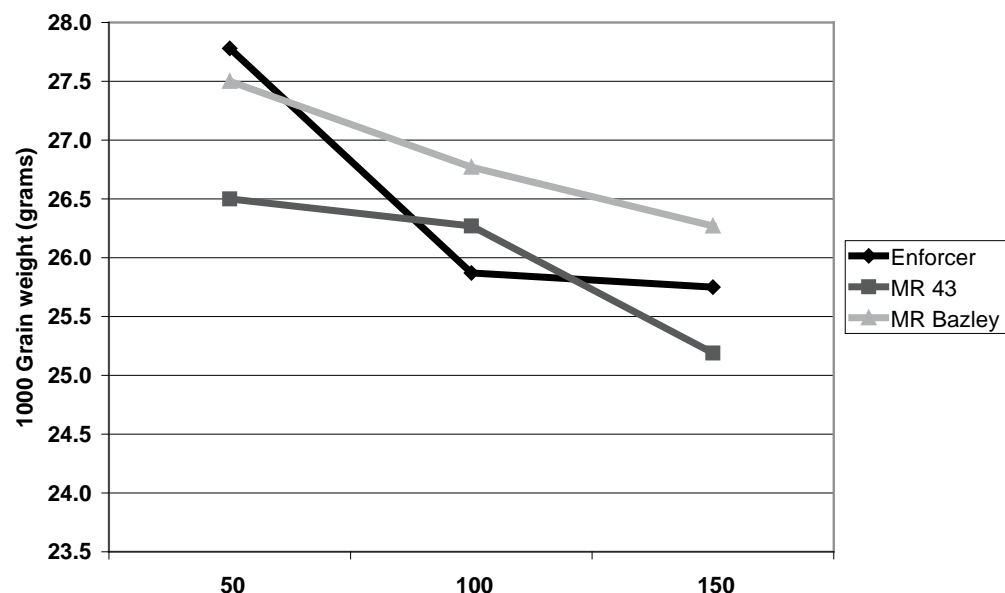
### 1000 grain weight

There was a significant impact of irrigation and hybrid, both alone and in combination on 1000 grain weight. The addition of one irrigation increased 1000 grain weight in all hybrids, and there was no statistical difference between the hybrids under this treatment. However under the dryland treatment, Enforcer had a significantly lower 1000 grain weight than the other two hybrids (Figure 2).



**Figure 2.** Effect of irrigation on 1000 grain weight of hybrids.

Varying plant population also had a significant impact on 1000 grain weight, as plant population increased, the 1000 grain weight decreased (Figure 3). Increasing plant population had the greatest impact on 1000 grain weight in Enforcer.



**Figure 3.** Effect of varying plant population on 1000 grain weight across hybrids.

#### Hectolitre weight

Hybrid was the only factor which had a significant impact on hectolitre weight. Enforcer had the highest hectolitre weight at 91.69 kg/hl, significantly higher than MR 43 and MR Bazley at 87.56 and 86.19 kg/hl, respectively. All of the hectolitre weights were very high (data not shown).

#### Summary

The use of one in-crop irrigation increased grain yields by 0.86 t/ha, reduced grain protein by 0.5% and increased 1000 grain weight.

Increasing plant populations from 50 to 100 or 150,000 plants/ha increased grain yields by 0.5 and 0.7 t/ha respectively. MR 43 and MR Bazley also showed increases in yield from increasing plant populations from 50 to 100,000 plants/ha, there was no significant difference between the 100 and 150,000 plants/ha treatments. Enforcer was less responsive to changes in plant population.

Varying nitrogen rate had very little impact on grain yield or quality at this site in this season. The primary impact was on increasing grain protein levels with each additional rate of nitrogen.

Individual hybrids showed varying reactions to altering the agronomic management practices. MR 43 and MR Bazley performed similarly under most treatments with Enforcer being lower yielding across all treatments.

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